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Predicting Events in the Development of a Coal Surface Mine in the West

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Because large areas in Western United States are underlain with coal deposits and because coal provides a source of energy needed in our present energy crisis, pressure to mine this coal is continually growing. Changes in the level of mining activities in rural areas can result in sudden and severe changes in every facet of community life. The opening of a mine, or a major expansion of a mine, can promote a "boomtown" phenomenon; the closing of a mine can leave large portions of a community unemployed. When any of these events happen quickly, the resultant changes may catch local people by surprise, thereby compounding the disruption.

Local officials and administrators of Federal and State governments often bear the brunt of responding to these disruptions. School systems suddenly find their enrollment doubled, tripled, or cut to one-half or less in the course of a couple of years. Other community services, such as health facilities, police and fire protection, or power, water, and sewage districts become either heavily overloaded or overbuilt. Public leaders find that their communities have new interests, new concerns, and different political structures, some of which require changes in leadership. Federal land managers find themselves caught up in controversy and facing different administrative responsibilities: a public with different values makes different demands of public lands.

Federal land managers are included in the group of officials and administrators affected by changes in mining activities for two reasons. First, much of the land in the West is Federal land, and is managed primarily by the Bureau of Land Management, U.S. Department of Interior, and the Forest Service, U.S. Department of Agriculture. Large deposits of coal underlie these public lands and pressure to mine this coal is increasing. Even when mining occurs on private lands, often there will be Federal lands nearby that are subjected to increased demands and pressures because of the adjacent activity. Secondly, although local administrators of the Bureau of Land Management and the Forest Service represent the Federal government and control the surface resources of the land they manage, mining laws permit them only limited and sharply defined authorities to control mining activities. As local administrators of these Federal agencies, therefore, they often find themselves in situations similar to those of administrators of community and State governments.

If local officials and Federal and State administrators are able to predict changes sufficiently early, the disruption resulting from changes in the level of mining activity can be minimized. With advance warning, programs can be adjusted, assistance can be sought, and plans can be made to deal with the disruptions. Local officials and administrators, however, must be aware that in most instances it may be directly against the mining company's interest to provide early or advance notice of its actions. These officials and administrators, as decisionmakers, therefore, must assume responsibility to predict changes in the level of mining activity on their own.

This report presents the steps in the development of a typical coal mine in the West and describes specific signs that local officials and administrators can use to predict when the next step will occur. It also briefly discusses how these signs can be used in alternative futures planning, a planning approach designed to enable programs to respond to sudden changes in the communities they serve.

COAL MINING IN THE WEST

Because of the sheer magnitude of all aspects of coal mining as compared with other uses of the same land, such as cattle ranching or wheat growing, a sudden change in the level of mining activity can cause major local disruptions, even under the best of circumstances. The degree of physical modification in surface mining, the size of the construction effort, the transportation system required to move the coal, the number of workers employed, the costs of constructing and operating a mine, and the returns per acre are all at least an order of magnitude greater than for any other use. Any major change in the level of mining activity, therefore, can represent major shifts in every aspect of community life. Some disruption is almost inevitable, but with advance warning of change, adjustments can be made to ease the transition and possibly limit the degree of disruption.

The administration of coal mines in the West is such that it encourages situations where local officials and administrators are not given notice of major changes. Because these officials and representatives of Federal land management agencies have only limited and sharply defined powers to control mining, their powers are concerned primarily with *how* mining is done, not *if* and *when*. For coal mining on Federally-controlled public lands, lease decisions are made in Washington, D.C. But a lease is not a decision to develop a mine at a given time. Ultimately, it is a private mining company that actually decides to change the level of mining activity in an area—to put a mine into production or to

close it down. And it is in the direct financial interest of private mining companies to keep confidential their intentions for as long as possible.

When a mining company first considers an area as a possible mine site, to announce the site could hurt the company in several ways. Other companies might also examine the area to find favorable sites first. Companies would compete for leases and mineral rights. Private individuals holding mineral rights could demand higher prices for these rights. Later, when physical exploration of an area is underway, a company benefits from limiting the amount of information it releases. Information about what the company finds or what level of exploration it will undertake in each location, if released, can help other companies to better predict locations of desirable coal deposits on other lands. Competition with the exploring company and the costs of obtaining mineral rights will increase. The same variables encourage delay in announcing that a mine actually will be developed in a certain location. The cost of planning, which can be large, is another variable that discourages mining companies from announcing precise plans in advance. The sooner construction begins after a mine is planned, the cheaper it is for the company. In fact, the usual procedure is for a mining company to prepare detailed plans only for that portion of the coal deposit to be mined under one mining permit, and to wait until the next permit application to prepare detailed plans for the next section of the coal deposit. Even for a 40-year mine, at any one time the company would have detailed plans only for what it will do in one 5-year period.

Requirements for permits provide local administrators and officials some advance warning that a coal mine is to open. This is not true for a mine closing: the instant a company decides that it is no longer economically wise to continue mining, the company can begin closure. It is in the financial interest of the company to close as quickly as possible once the decision is reached. While the decision is being considered, but before it is actually reached, it is in the company's interest not to release this information. Rumors of the mine closing, or continued uncertainty, can hurt productivity, lower employee morale, affect the value of company stock, and can have a negative influence on the behavior of suppliers and markets with which the company deals.

PREDICTING CHANGES IN MINING ACTIVITY

Because local decisionmakers and Federal representatives must learn to predict changes themselves, the first step is to learn as much as possible about coal mining. What are the steps in coal mining? How is mining actually done? What types of mines are there? Answers to some of these questions are given in the appendix of this report. In addition, the booklet "Anatomy of a Mine" is a thorough treatment of the types and mechanics of mining, and readers are encouraged to send for this booklet. It is available on request to the Director, Intermountain Forest and Range Experiment Station, 507 25th St., Ogden, Utah 84401.

Having obtained a general knowledge of coal mining, the next step is to learn to watch for those conditions that influence the timing of the steps in the development of a coal mine. These conditions are signs that can be used to predict changes in the level of mining activity in an area. Three types of conditions are especially useful for prediction: prerequisites, precludors, and trigger events.

Prerequisites are those conditions or events that *necessarily* occur before a major step in the sequence of mine development may be taken. Some of these prerequisites are merely earlier steps. A potential coal mine developer, for example, would go through several steps before reaching the point at which it would be economically feasible to acquire land rights. These steps would include mapping the land, analyzing its potential to produce coal profitably, meeting legal requirements, and, at least, minimally acceptable social, physical, and economic standards. Prerequisites can be used in two ways to determine when a step in the development of a surface mine will occur. First, as long as the prerequisites for a step have not been fulfilled, that step will not happen. This is useful information by itself, especially if the length of time it takes to complete the prerequisites is known. In this situation, the time period is the minimum length of time before the step can occur. Second, watching the degree of effort mining companies put into fulfilling prerequisites is a good indicator of their intentions.

Precludors are, in a sense, the opposite of prerequisites, but are used in similar ways. A precludor is a condition or event that prevents a major activity or step from happening in the mining development sequence. A substantial decrease in the overall demand for coal, for example, may delay or stop a company, previously interested, from obtaining mineral rights for land overlaying coal. Denial of a permit required before a step can proceed is another example of a precludor.

Trigger events are, perhaps, the most important conditions or events to watch for in predicting when a mine development step will take place. Unlike prerequisites or precludors, which merely allow or prevent a step from taking place, trigger events are those events that help to cause or initiate a major step. They are the stimuli to which those involved in coal mining respond. Some trigger events are linked to changes in demands for coal. A price increase for coal, for example, may make those areas that are economically only marginally feasible for development suddenly become economically attractive. Other trigger events are those that decrease the financial risks of mine development. The discovery of a marketable coal deposit on one tract will almost invariably stimulate physical exploration in surrounding tracts, because the probability of getting a return on exploration costs is higher in these situations. Events that decrease cost of mine development—monetary, political, or environmental—also make mine development more attractive and may initiate the next step in the development sequence.

By identifying, and then watching for, precursors, precludors, and trigger events, those people not involved in coal mining development but affected by it can predict which steps in the sequence of mine development will or will not happen. For the steps that will occur, these indicators can be used to identify when the step will be taken. Often a prediction can be made well in advance of the event.

SIGNS OF CHANGE

Certain steps in the development of a standard coal mine in the West, along with specific precursors, precludors, and trigger events, are useful for predicting when or if an event will take place *(Appendix)*.

The steps in the sequence provided were identified by a review of available literature on surface mine development and by questioning knowledgeable people in industry and government. The specific procedure involved in locating, securing, and developing an economically mineable coal reserve may vary considerably throughout the industry depending on the size, past experiences, and philosophy of the company. It may also vary from mine to mine depending on the location, physical characteristics, available information, and legal status of the coal reserve in question. The steps listed are "standard" steps a mine developer usually must go through. They are given in the order in which they would most likely be carried out, although this is not to imply that a mine cannot be developed without following these steps, especially in the early planning stages. Where not required by law, for example, activities related to environmental considerations may or may not be carried out early in the mine planning process. Where possible, an estimate of the time needed to complete a step is also given, but it must be recognized that these are only estimates and the actual amount of time may vary significantly because of local conditions.

ALTERNATIVE FUTURES PLANNING

Learning to predict major changes in the level of coal mining activity is one way to reduce the disruption resulting from these changes. Another way is for local officials and administrators to adopt planning and management approaches that both prepare them and leave them the flexibility needed to deal with major, unpredicted changes. Alternative futures planning is one such approach (Thor 1979).

In alternative futures planning, a wide range of possible futures are considered and examined. The local official or administrator determines how to deal with each of these futures, and, very importantly, how the activities for one future could affect a response to another. This helps identify key decisions which, once made, foreclose important options. Often these key decisions do not have to be made for some time, and only traditional planning practices have caused them to be made early. In alternative futures planning the timing of when these decisions must be made to respond to different futures is identified. Sometimes a decision is put off until later in the belief that this delay will lead to a better decision because of additional information. Other decisions, if made promptly, however, will open up future options and the decisionmaker's ability to respond to different futures. Alternative futures planning identifies these for prompt action. The result of alternative futures planning is a course of action for the near future, and a description of key decisions to be made at another time. This description includes what the choices are, what assumptions and information will probably be needed to make the decision, and when or under what conditions each decision must be made.

The *first step* in alternative futures planning is the preparation of a relatively small number of written scenarios describing possible futures for the planning area. Each scenario provides a brief picture of one possible long-term future, and is centered generally around major trends or events largely outside the control of the local official or administrator. The discovery and development of a large coal field in an area, for example, could be one such event. Other scenarios could be built around different possible court rulings on water rights and Federal land, massive, synthetic fuel developments supported by the Federal government, or on the States gaining control of Federally-managed public land. The final stage in preparing the scenarios is to identify key issues and demands for each scenario that define the management problem facing the local official or administrator, if that scenario were to occur. What would each agency have to do in the case of a boom-town, a flood of exploration permit applications, or the closing of a mine? Because the remainder of the planning process is aimed at responding to these management problems, it is essential that issues and demands are identified carefully.

Having identified the management problem for each scenario, the *second step* is to determine the official's or administrator's capability to respond to these problems. What resources would be available under each scenario? What physical, legal, social, or economic limitations would be placed on their use? Where this information is not readily available, inventories and information collection efforts must be undertaken. Local officials may want to prepare lists of persons and agencies to turn to for help, or of actions taken by other officials and towns in similar situations. Once this information is assembled, it is analyzed to assess the range of feasible actions the manager could take, how these actions would help to alleviate the management problem, and any special limitations on these actions.

The *third step* in alternative futures planning is to determine the goals, objectives, and decision criteria that will control the development of the plan and the choice among alternatives. These are developed on a scenario-by-scenario basis in terms of the issues and demands, and the capability to respond to those issues within each scenario. One objective, for example, could be to be sure that no retired persons are forced out of their homes by higher prices and taxes in the event of a boom-town situation. Second, additional goals, objectives, and decision criteria are developed that allow a comparison between scenarios. This is where relative values are established for meeting a particular objective under one scenario as opposed to meeting another objective under a different scenario. Some of these additional goals, objectives, and decision criteria provide guidance for what to do when the aims and emphases are different or conflicting between scenarios. Others address the acceptable degree of risk that the objectives of a particular scenario will not be met, if that scenario occurs. Local agencies, for example, may be willing to risk crowding of the local schools, rather than to pay for schools that may not be needed. These same agencies,

however, may be willing to put considerable time and expense into assuring that the agricultural water supply will not be cut off.

These second and third steps do not occur in strict chronological order, but instead, there is cycling and feedback. It is necessary to have a good idea of what actions are possible before goals, objectives, and decision criteria for choosing among these actions can be developed. Much of step two, therefore, must be completed before step three. At the same time, however, efficient gathering of information requires knowledge of what questions the information will be used to answer. For planning, the description of the official's or administrator's ability to respond to management problems must be expressed in terms compatible with the goals, objectives, and decision criteria used to evaluate those reponses. To assure that the correct information is available and time is not wasted gathering unnecessary information, the goals, objectives, and decision criteria should be largely developed before any expensive inventory or feasibility study is undertaken.

The *fourth step* in alternative futures planning is to identify the cross impacts of different activities. The decisionmaker examines how actions taken to respond to one scenario's management problem would affect his ability to take actions appropriate to other scenarios. If one type of sewage treatment plant is built for a small local population, for example, can it be expanded to handle a large boom-town situation? Key decisions are identified that either foreclose potentially important options once they are made or create options if made promptly. Particular attention is given to the order in which actions can occur and when the decision to take these required actions must be made if they are to have the desired result.

The *fifth step* in alternative futures planning is to isolate events and conditions that can be used in the future to determine which scenario will occur or is occurring. It is here that precursors, precludors, and trigger events are identified. For coal mining scenarios the precursors, precludors, and trigger events from the *Appendix* can be used, or modified to fit local conditions.

The *sixth step* is the choice of "the" plan to be followed by the decisionmaker and staff, using all of the information generated in the preceding steps. In some respects this plan is like any other management plan to determine programs and lay out a course of action for the immediate future that will accomplish the overall goals and objectives. In addition to management activities for the immediate future, however, the plan specifies key decisions that are not to be made at this time because the benefits of making a commitment are outweighed by possible costs of being unable to respond to one of the future scenarios as a result of making these decisions early. The plan indicates what the choices are, the decisions, when or under what conditions they need to be made, and what information or assumptions will probably be needed to make the decisions. It also lists prerequisites, precludors, and trigger events to be watched for in assessing which scenarios will occur and, therefore, which alternative actions should be taken. The plan might indicate, for example, that the local District Manager of the Bureau of Land Management or the Forest Supervisor of the Forest Service should watch the filing of deeds for mineral rights on adjacent private lands. When a sudden increase in filing of deeds occurs, the manager or supervisor should follow the portion of the plan that responds to a future of coal mining development. The plan usually includes a request for a minerals specialist, additional staff, and clerical support in the manager's or supervisor's next program, and, a budget request to process all of the permit applications that are likely. (Note that an initial budget request often must be made 3 years in advance of when the money is needed and, therefore, early action is essential.) The plan also indicates the basic assumptions that must hold and the events that can or cannot happen for the current plan to be valid. This is an indicator of when the plan must be updated.

The general procedure for choosing the plan is the same as that used in any decision process: alternatives are developed, evaluated, and the one alternative that best meets the overall goals, objectives, and decision criteria is selected. How this is done specifically depends on the degree to which analytical decision aids are used. At one extreme, general management rules are developed and followed, such as: delay those decisions that remove the most options as long as possible, take special care to maintain flexibility in the use of those resources needed to reach the most difficult objective under each scenario, or take those actions common to all scenarios first. At the other extreme, the plan can be selected through the use of optimization techniques, such as stochastic programing that incorporates the uncertain future and cross-impacting actions into a mathematical solution.

The *final step* of alternative futures planning is repeated for as long as the plan is in effect. This step includes carrying out the actions and making the decisions identified in the plan, and amending or revising the plan. A minor revision is made when it is determined that one of the scenarios is occurring, or the probability of the different scenarios occurring has changed. On the basis of the additional information, more refined management direction is developed. Where the plan states, "If this happens we will do so and so," the revision states, "This is happening, with minor modifications, perhaps and, therefore, this part of the plan will be implemented and other parts downplayed." A major modification of the plan is necessary when it becomes apparent that none of the scenarios described in the original plan is occurring and, therefore, a new plan must be developed.

LITERATURE CITED

Cassady, Jon M.
1975. **Obstacle course for permits and approval.** Min. Congr. J. 61(9):52-55.

Cochran, Neal P.
1976. **Oil and gas from coal.** Sci. Amer. 234(5):24-29.

Code of Federal Regulations (30th).
Chapter 7. **Surface coal mining and reclamation operations permanent regulatory program.**

Guccione, Eugene.
1978. **Railroads vs. pipelines: there's room for both.** Coal Min. and Process. 15(2):48-51.

Jones, James R.
1977. **The process of developing a western coal mine.** *In* Mining yearbook 1977. Papers presented at the 80th national western mining conference and exhibition. p. 132-138. Colo. Min. Assoc., Denver.
Pentz, David.
1977. **Open pit mining.** Mining and mineral resources 1977. Coll. Eng., Interdisc. Stud. Cent. Rep. 78-3:211-228. Univ. Calif., Berkeley, Calif.
Springman, Roger.
1977. **A timetable for state agency actions: the mine development process.** Wisc. Off. State Plann. and Energy, Dep. Admin., Madison, Wisc. 65 p.
Stroud, Garner R.
1976. **Acquisition of coal rights—it's different.** *In* Proc. 21st Annu. Rocky Mt. Mineral Law Inst. July 1975, p. 587-615.
Thor, Edward C.
1979. **Alternative futures planning: Decisionmaking for an uncertain future.** *In* Proc. 8th Annu. Meet. Amer. Inst. Decision Sci., West. Reg. Conf. [Reno, Nev. March 21-23, 1979], p. 303-306.
U.S. Code (16th).
Endangered Species Act of 1973. PL 93-205; 87 Stat. 884.
U.S. Department of the Interior.
1977. **Mining and minerals policy—annual report of the Secretary of the Interior under the Mining and Minerals Policy Act of 1970.**
U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement.
1978. **Draft regulations—surface mining and reclamation operations permanent regulatory program.** July 21, 1978.
U.S. Mountain Plains Federal Regional Council.
1977. **Preliminary draft of permitting procedure for surface mining of coal on Federal lands or coal deposits.** Denver, Colo., 4 p.
U.S. Senate, Committee on Energy and Natural Resources.
1977. **Surface Mining Control and Reclamation Act of 1977, hearings before the Subcommittee on Public Lands and Resources.** Washington, D. C., 168 p.

APPENDIX:

SEQUENCE OF COAL MINE DEVELOPMENT

Definitions:

Prerequisite
An event that *necessarily precedes* the major activity.

Precludor
An event that most likely would *prevent* the major activity from occurring.

Trigger event
An event which, if it occurs, *may initiate* the major activity.

Land and Mineral Rights Obtained

- Surface and mineral ownership of reserve area mapped by mining company.[1]
- Cursory environmental, economic, and geologic analyses favorable.
- Mining company landperson contacts private holders of surface and mineral rights; lease or purchase, or contract with option to purchase negotiated (Stroud 1976).
- If Federal land involved, lease obtained from Bureau of Land Management—minimum 2 years to lease award (U.S. MPFRC 1977).

- Decreased demand for coal because of decrease in overall demand for energy or development of alternate energy technology.
- Change in technology resulting in decreased demand for rank of coal on land under consideration.
- Change in tax rules, government allowances, or environmental protection standards unfavorable to industry.
- Leasing or private land acquisition process takes overly long, mining company loses interest because of acquisition of better lands, lack of funds, loss of potential market, and other reasons.
- Tracts of land essential to complete a logical mining unit cannot be leased or purchased because of private landowner holdouts (Stroud 1976); specific legislation prohibits mining on certain Federal lands.
- Environmental problems identified which make mining impractical.[2]
- Bureau of Land Management does not approve essential lease, or lease goes to alternate bidder.

- Market for and/or price of coal increase(s).
- Federal coal leasing program begins.
- Change in tax rules, government allowances, or environmental protection standards favorable to industry.
- Improved mining or reclamation technology developed.
- Improved public attitude toward strip mining because of severe energy shortage, major accident involving an alternate source of energy, observation of successful reclamation, or improved technology.
- Eminent domain rights extended to coal slurry pipelines; areas where rail, truck, or boat transport of coal was economically not feasible now become feasible to mine (Guccione 1978).
- Increasingly stringent sulfur dioxide (SO_2) emissions standards make Western low sulfur coal more competitive.
- Development of competitive coal to synthetic fuel conversion industry (Cochran 1976).
- Bid request received from potential customer (Jones 1977).
- Mining company looking for available reserve while seeking a market (Jones 1977).

Physical Exploration

(Time estimate: from 6 to 18 months to completion)

- Federal lease and/or State/private drilling rights obtained.
- Literature search to determine geology, previous discoveries, and access routes completed; information mapped on base maps or aerial photos.

- Equipment or personnel not available.
- Preliminary information obtained from literature and field shows area to be highly unfavorable.
- Lease application denied.

- Significant coal deposit discovered.

[1] Personal communication from Jon M. Cassady, Amax Coal Company, Indianapolis, Ind., August 30, 1978.

[2] Personal communication from James R. Jones, Peabody Coal Company, St. Louis, Mo., July 18, 1978.

Prerequisite	Precludor	Trigger event
• Completion of geological reconnaissance (may require use of airplane or helicopter) to select best locations for detailed geological studies (U.S. Dep. Int. 1977).	• Drilling rights not obtained.	
• Exploration plan designed.	• Regulatory agency does not approve proposed exploration and reclamation operations. Agency has determined operations will: a. Not be conducted in accordance with the coal exploration performance standards specified in 30 CFR Ch. 7, Pt. 814, Subch. K; b. Adversely affect an endangered or threatened species listed pursuant to Section 4 of the Endangered Species Act of 1973 (16 USC Sec. 1531); c. Adversely affect any object listed on the National Register of Historic Places unless approved by agency with jurisdiction.	
• For coal operations in which less than 250 tons of coal are removed in any one location, notice of intention to explore filed with regulatory agency (30 CFR Ch. 7, Pt. 776.11(a)).		
• For coal operations in which more than 250 tons of coal are removed: application for approval filed with regulatory authority, public notice given in vicinity of proposed exploration area, application approved by regulatory agency, and notice placed in newspaper of general circulation in vicinity (30 CFR Ch. 7, Pt. 776.11b).		
• Other licenses and permits obtained as necessary, for example, FCC special radio operator license, FAA landing tower and strip license, IRS explosive user's and/or manufacturer's license, surface management agency right of way permit (U.S. MPFRC 1977).	• Other permits denied.	
• Performance bond posted (30 CFR Ch. 7, Pts. 742 and 802).	• Litigation in progress against mining operations.	
• Drilling and construction bids released and contracts awarded.		
• Field office established (Springman 1977).		
• Access roads and buildings completed.		
• Drilling equipment and personnel arrive on site.		

Initial Environmental Reconnaissance

(Time estimate: 30 days)

• Literature search for existing environmental information completed.		• Exploratory drill rigs confirm existence of marketable coal.[2]
• Exploration underway.		• Concern over environmental effects of mining this site expressed by some segment of public.
• Company has qualified personnel or contracts for work.		

Economic Analysis, Feasibility Assessment

• Results of drilling program analyzed, reserve is determined to be commercially mineable and marketable (Jones 1977).	• Delays in analysis of drilling data; insufficient data to make decision.	• Company has potential market for coal.
• Initial environmental reconaissance of area results in favorable environmental report (Jones 1977).	• Environmental report indicates serious environmental constraints or possible impacts that would be difficult to mitigate; unlikely company can mine economically and stay within government regulations.	
• Preliminary mining plan designed; in-house inventory of available equipment (Pentz 1977).	• Inability to develop economical transportation to market. [1]	

[1] Personal communication from James R. Jones, Peabody Coal Company, St. Louis, Mo., September 11, 1978.

Prerequisite	Precludor	Trigger event
Identification of Potential Customer		
• Market survey done by company (Jones 1977). • Data from drilling program analyzed for needs of customer (Jones 1977).	• No customers available because of: a. Rapid increase in local or regional coal prices, b. Reduction in local or regional prices of alternate energy source, or c. Inaccurate market survey.	• Bid request received from potential customer.
Environmental Assessment Report		
• Positive feasibility decision made. • Field program for environmental assessment designed—15 to 30 days (U.S. Senate 1977). • Consultant selection if needed (Jones 1977)—4 to 6 weeks.[4] • Baseline environmental and geological data, engineering information collected, contour maps completed—1 year (U.S. Senate 1977).[2] • Report assembled into required format—90 days.[2]		
Detailed Project Design		
• Positive feasibility decision made. • Baseline environmental data collected. • Best future use of land determined.		• Contacts with contractors, equipment manufacturers, labor unions (Springman 1977). • Frequent contacts with local planners, other government agencies.
Application for Mining Permit Submitted		
• Environmental assessment report completed and favorable. • Mining and reclamation plans designed. • Board of Directors of mining company makes development commitment (Springman 1977). • Market for coal identified (U.S. Senate 1977) and details of customer's needs known (Jones 1977). • Surface rights secured. • Mine Safety and Health Enforcement Administration contacted for mine identification number—2 to 3 days.[5]		

[4] Personal communication from Catherine Pahl, Dames and Moore, Denver, Colo., July 13, 1978.

[5] Personal communication from Rita Weaver, Mine Safety and Health Admin., Health & Safety Analysis Center, Denver, Colo., August 4, 1978.

Prerequisite	Precludor	Trigger event
Mining Permit Issued		
• Mining permit approved by regulatory agency—60 or more days (U.S. Senate 1977).	• Litigation.	
• Performance bond post (30 CRF Ch. 7, Pts. 800.11 and 742.12).	• Permit denied, hearing requested, 30 days to advertise hearing, 30 days for agency to respond (U.S. Senate 1977).	
	• Mining plan found to include areas designated unsuitable for mining under 30 CFR Ch. 7, Subch. F. Such areas are defined as: a. On any lands within boundaries of, or adjacent areas necessary to prevent impacts on, the National Park System, National Wildlife Refuge System, National System of Trails, National Wilderness Preservation System, Wild and Scenic Rivers System, and National Recreation Areas. b. On any Federal lands within boundaries of any National Forest except where the Secretary of the Interior determines there are no significant recreational, timber, economic, or other values incompatible with surface mining and the Secretary of Agriculture determines that on lands which do not have significant forest cover west of the 100th meridian, mining operations comply with Multiple Use Sustained Yield Act 1960, 1975 Federal Coal Leasing Amendments, and 1976 National Forestry Management Act. c. Where mining operations would adversely affect any public park or any places included on, or eligible for listing in, the National Register for Historic Places unless otherwise approved by both the Federal, State, or local jurisdiction over the park or historic place and the regulatory authority. d. Within 100 feet of the outside right-of-way line of any public road except where mine access or hauling roads join the right of way or the regulatory authority allows the road to be relocated or determines landowners' interests will be protected. e. Within 300 feet of any occupied dwelling unless owner has provided a written waiver. f. Within 300 feet of any public building or park, school, church, community, or institutional building. g. Within 100 feet of a cemetery. h. Unsuitable under State or Federal regulatory programs.	
Arrange for Labor		
• Permits issued or no problems foreseen.*	• Delay in permit approval process.	• Construction materials arrive
• Heavy equipment arrangements made.*	• Delay foreseen in heavy equipment arrival, or manufacturer not able to supply equipment ordered.	

* Personal communication from Dale Burgaard, Amax Coal Company, Denver, Colo., July 19, 1978.

Prerequisite	Precludor	Trigger event
Construction Begins (Construction takes from 6 months to 2.5 years.)		
• Construction plans approved and permits issued.	• Delay in receiving permits.	• Stripping equipment arrives at site.
• Financing arranged.[1]	• Labor, materials, or construction equipment do not arrive at mine site.	
• Construction bids released and contracts awarded (Springman 1978).	• Labor strike.	
• Construction equipment arrives.	• Market for coal falls through.	
• Construction labor arrives.	• Adverse weather conditions. (Springman 1978).	
	• Material shortages (Springman 1978).	
	• Litigation.	
	• Mining permit terminated because operations have not commenced within 3 years of issuance of permit unless extension granted because of litigation or conditions beyond control of permittee (30 CFR Ch. 7, Pt. 786.11(b)(1)).	
Production Begins		
• Construction completed.	• Construction delays.	
• Heavy equipment assembled (about 18 months).	• Labor strike.	
• Labor arrives.	• Technical problems in start-up phase.	
• Start-up phase successful.		
Unplanned Shut Down of Mine		
		• Federal or State investigation finds a condition or practice that creates imminent danger to public health or safety, or which may cause significant environmental harm. Cessation order issued (30 CFR Ch. 7, Pt. 843.11(a)(1)).
		• Notice of violation issued (30 CFR Ch. 7, Pt. 843.12(a)).
		• Regulatory agency determines pattern of violations exists and issues order to show cause (30 CFR Ch. 7, Pt. 843.13).
		• Decrease in demand for and/or price of coal.
		• Change in tax rules, government allowances, or environmental protection standards unfavorable to industry.
		• Company goes bankrupt.
		• Company unable to expand mine as planned because of lack of market for additional coal or inability to obtain additional land or permits.
Performance Bond Released		
• All openings and excavations closed or backfilled according to mining plan (30 CFR Ch. 7, Pt. 744.7(h)(3)).		

Prerequisite	Precludor	Trigger event
• Equipment and structures related to mining removed (30 CFR Ch. 7, Pt. 744.7(h)(3)).		
• Areas affected by access roads graded, drained, and revegetated according to mining plan (30 CFR Ch. 7, Pt. 744.7(h)(3)).		
• Notice of intention to cease or abandon operations filed by mine operator with Office of Surface Mining Reclamation and Enforcement Regional Director at least 30 days before cessation or abandonment. Mine inspected by Regional Director, Mining Supervisor, and others to check compliance with mining plan and lease, permit, and license stipulations (30 CFR Ch. 7, Pt. 744.7(h)(4)).		
• If the Federal government has surface rights to the land, the owner has been contacted and owner's comments taken into account before the bond is released (30 CFR Ch. 7, Pt. 744.7(h)(5)).		
• Notice of availability of the proposed decision to release the bond posted in a local newspaper for 2 weeks.		
• Notice of availability of proposed decision to release the bond posted in State or regional offices of U.S. Geological Survey, Bureau of Land Management, Office of Surface Mining, and other appropriate agencies; and published in the *Federal Register* not less than 20 days before the decision (30 CFR Ch. 7, Pt. 744.7(h)(6)).		

Ferrante, Lynn M., and Edward C. Thor.
1980. **Predicting events in the development of a coal surface mine in the West**. Gen. Tech. Rep. PSW-41, 11 p. Pacific Southwest Forest and Range Exp. Stn., Forest Serv., U.S. Dep. Agric., Berkeley, Calif.

Sudden changes in the level of coal mining activity in an area can cause immediate and profound changes in every facet of life in a rural community. Local officials and administrators of Federal and State governments often bear the brunt of responding to the disruptions that result from these changes. The nature of coal mining in the West is such that the community in general and the resource managers and officials involved often do not receive sufficient warning of the changes in mining and so are caught unprepared. By learning what signs to look for, however, these decision makers can preduct such changes and thereby be prepared to deal with them.

Retrieval Terms: rural environment, change agents, community change, prediction, strip mining, surface mining